JurnalPeternakanIntegratif

Effect of Fermentation Duration and Dosage of EM4 on Maturity Level and Quality of Fermented Compost Fertilizer.

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Abstract. Livestock waste often causes pollution around the cage. Processing of livestock waste such as compost can be used as fertilizer for plants with good enough nutrient content given to plants. In order to produce good compost, it require a fermentation process. One way that is rarely used to determine the maturity level of compost is by measuring the carbon dioxide gas content in fermented compost. Measurement of carbon dioxide gas can be done using a tool in the form of a carbon dioxide sensor. The research design used was a 7 x 3 randomized block design with 2 replications, while the parameters studied were N, P, K, Moisture Content, pH, Temperature, C/N, Carbon Dioxide.

Keywords: compost, carbon dioxide, fertilizer, fermentation, sensor

1. Introduction

Compost is organic material consisting of several types, namely rice straw, leaves, rice bran, corn stalks, grasses, vegetable waste, and also often used by many people, namely from animal waste that has undergone a decomposition process. by decomposing microorganisms, so it can be used to improve soil properties. Since ancient times, livestock manure such as cow manure has been used as plant fertilizer. Processing cow manure which has high N, P, and K content as compost can supply the nutrients needed by the soil and improve soil structure for the better [1]. However, the utilization that can be done is not through the process of making organic fertilizer first. So that the utilization is not maximized. In general, mature compost can be characterized by the following characteristics 1) dark brown to black in color similar to the color of the soil, 2) insoluble in water, although some compost can form suspensions, 3) C/N ratio of 10-20, depending on from the raw material and the degree of humification, 4) good effect when applied to the soil, 5) the temperature is approximately the same as the ambient temperature, and 6) odorless [2]. In the composting process there will be a chemical change including changes in

carbohydrates, cellulose, hemicellulose, fats, and waxes turning into CO2 and H2O, and the decomposition of organic compounds into compounds that can be absorbed by plants [3]. Cow waste is a material that contains nutrients such as N, P, and high K so that the processing of compost from cow feces can improve the nutrients in the soil and can also change the soil structure for the better [4]. Good soil conditions will affect the increasing solubility of organic matter, the emergence of amino acids, sugars, vitamins, and parts of bioactive substances from microorganisms in the soil will increase, and this will affect the maximum plant growth [5].]. This study aims to determine the relationship and quality of compost fermented with EM4 based on different fermentation times and doses with the help of a carbon dioxide (CO2) sensor. sugars, vitamins, and parts of bioactive substances from microorganisms in the soil will increase, and this affects the maximum plant growth [5]. This study aims to determine the relationship and quality of compost fermented with EM4 based on different fermentation times and doses with the help of a carbon dioxide (CO2) sensor. sugars, vitamins, and parts of bioactive substances from microorganisms in the soil will increase, and this affects the maximum plant growth [5]. This study aims to determine the relationship and quality of compost fermented with EM4 based on different fermentation times and doses with the help of a carbon dioxide (CO2) sensor.

2. Materials and methods

This research was conducted at the UPT Integrated Research Laboratory, University of North Sumatra. This research took place from September to October 2021.

The materials used in this study were stardec and EM4, 35% cow feces, 30% chicken manure, 10% palm fronds, 10% palm leaves, 15% straw, molasses, and water.

The tools used in this study were a Duran bottle as a place to ferment compost, a shovel for stirring cow dung, tarpaulins, buckets, scales, thermometers, pH measuring instruments.

2.1. Research design

This research was conducted using a randomized block design (RAK) with 7 x 3 factorial pattern. The first factor was the difference in fermentation time, then the second factor was the dose of EM4 used. Each treatment was repeated 2 times.

Tabel 1. Research Design of Compost Treatments

Fermentation Time (T)	EM4 . dose		
	D1 (1%)	D2 (2%)	D3 (3%)
1 day	U1D1T1	U1D2T1	U1D3T1
2 days	U1D1T2	U1D2T2	U1D3T2

3 days	U1D1T3	U1D2T3	U1D3T3
4 days	U1D1T4	U1D2T4	U1D3T4
5 days	U1D1T5	U1D2T5	U1D3T5
6 days	U1D1T6	U1D2T6	U1D3T6
7 days	U1D1T7	U1D2T7	U1D3T7

2.2. Observed variables

1. Nitrogen Content (N)
2. Phosphorus Content (P)
3. Content of Potassium (K)
4. C/N ratio
5. pH
6. temperature
7. Water content
8. carbon dioxide

2.3. Data analysis

The data obtained and analyzed by Randomized Block Design, if the obtained data results are very real or real, then proceed with Duncan's test.

2.4. Research stages

2.4.1. Making compost

Weigh every ingredient used for making compost. Mix well all the ingredients that have been weighed. Then put it in the Duran bottle when the compost is evenly mixed and close the Duran bottle tightly. The compost fermentation time was observed according to the treatment.

2.4.2. Compost fertilizer quality testing

- NPK Measurement

Turn on the NPK meter, open the Duran bottle which contains fermented compost. The NPK meter measuring instrument is inserted into a Duran bottle containing fermented compost. Wait until the NPK meter displays the number for the NPK content in the compost.

- Carbon dioxide measurement

The carbon dioxide sensor is inserted into the Duran bottle that already has the fermented compost. Judging from the value of the carbon dioxide gas content in the compost using a computer that is connected to the sensor in the Duran bottle.

- pH measurement

Turn on the pH meter. The pH meter is inserted into the Duran bottle which already contains fermented compost. Wait until the pH value appears.

3. Results and Discussion

3.1. Nitrogen

Table 2. Test Results for Elemental N in Fermented Compost with EM4 At a dose of Different

Fermentation Time (T)	EM4 (D) DOSAGE			Average
	D1 (1%)	D2 (2%)	D3 (3%)	
T1 (1 Day)	1.00	0.75	0.80	0.85
T2 (2 Days)	0.75	0.95	0.75	0.81
T3 (3 Days)	0.85	0.90	0.75	0.83
T4 (4 Days)	0.75	0.80	0.85	0.80
T5 (5 Days)	0.70	0.75	1.00	0.81
T6 (6 Days)	0.80	1.00	1.10	0.96
T7 (7 Days)	0.90	1.05	1.15	1.03
Average	0.82	0.88	0.91	

Description: The same superscript in different rows and columns showed no significant difference (P>0.05)

Based on the results of this study, it can also be seen that EM4 does not significantly affect the increase in nitrogen elements, and the length of fermentation time also does not show an effect on increasing nitrogen elements. The presence of the nitrogen element is due to the materials used in the composting already available nitrogen elements in it.

3.2.Phosphorus

Table 3. Test Results of Element P in Fermented Compost with EM4 At the same dose different

Fermentation Time (T)	EM4 (D) DOSAGE			Average
	D1 (1%)	D2 (2%)	D3 (3%)	
T1 (1 Day)	1.30	1.30	1.30	1.30
T2 (2 Days)	1.30	1.10	1.25	1.21
T3 (3 Days)	0.50	0.80	1.00	0.76

T4 (4 Days)	0.90	1.10	1.05	1.01
T5 (5 Days)	1.00	1.05	1.20	1.08
T6 (6 Days)	0.95	1.15	1.25	1.11
T7 (7 Days)	1.20	1.25	1.20	1.21
Average	1.02	1.10	1.17	

Note : The same superscript in different rows and columns shows no significant difference (P>0.05)

Based on the results of this study, it can be seen that the longer the fermentation time and with the EM4 dose of 1-3 percent, the Phosphorus element obtained in the fermentation product does not increase. This is because the bacteria specifically for the solubilization of phosphorus in EM4 is not given much in the composting process so that the phosphorus content does not increase in the fermentation process. Most of the phosphorus comes from the artificial weathering of natural minerals, the rest comes from the weathering of organic materials [6].

3.3. Potassium

Table 4. Test Results for Element K in Fermented Compost with EM4 At the same dose different

Fermentation Time (T)	EM4 (D) DOSAGE			Average
	D1 (1%)	D2 (2%)	D3 (3%)	
T1 (1 Day)	2.85	3.30	1.50	2.55
T2 (2 Days)	3.15	2.95	3.00	3.03
T3 (3 Days)	1.90	1.85	2.10	1.95
T4 (4 Days)	2.40	2.15	2.85	2.46
T5 (5 Days)	2.60	2.75	3.00	2.78
T6 (6 Days)	2.45	2.60	2.35	2.46
T7 (7 Days)	2.75	3.00	2.80	2.85
Average	2.58	2.65	2.51	

Description: The same superscript in different rows and columns showed no significant difference (P>0.05)

Based on the results of this study, it can also be seen that the use of EM4 has no significant effect on increasing the elemental potassium. And the length of time of fermentation also did not show an effect on the increase in potassium elements. Therefore, it can be said that the longer fermentation time and the use of EM4 doses of 1 to 3 percent did not affect the concentration of the elemental Potassium.

3.4. C/N

Table 5. Test Results for C/N Elements in Fermented Compost with EM4 At a dose of different

Fermentation Time (T)	EM4 (D) DOSAGE			Average
	D1 (1%)	D2 (2%)	D3 (3%)	
T1 (1 Day)	19.73	33.36	23.42	25,50
T2 (2 Days)	17.72	23.21	23.66	21.53
T3 (3 Days)	17,20	20.05	33.07	23.44
T4 (4 Days)	31.28	9.02	32.61	24.30
T5 (5 Days)	32.83	34.89	24.80	30.84
T6 (6 Days)	27.45	25.53	21,13	24.70
T7 (7 Days)	21.62	19.49	21,12	20.74
Average	23.97	23.65	25.68	

Description: The same superscript in different rows and columns showed no significant difference (P>0.05)

Based on the results of this study, it can also be seen that the use of EM4 has no significant effect on increasing the elemental ratio of C/N. And the length of time of fermentation also did not show the effect of increasing the elemental ratio of C/N. Therefore, it can be said that the longer fermentation time with a dose of 1 to 3 percent EM4 does not affect the concentration of elements in the C/N ratio. This can be caused by differences in the value of nitrogen and carbon during the composting process, these changes occur due to the decomposition of complex organic compounds into simple organic acids and the decomposition of organic matter containing nitrogen.

3.5. pH

Table 6. pH test results in fermented compost with EM4 at different doses Different

Fermentation Time (T)	EM4 (D) DOSAGE			Average
	D1 (1%)	D2 (2%)	D3 (3%)	
T1 (1 Day)	6.35	5.65	6.55	6.18
T2 (2 Days)	6.55	6.60	6.50	6.55
T3 (3 Days)	6.60	6.00	6.20	6.26
T4 (4 Days)	6.25	6.55	6.60	6.46
T5 (5 Days)	6.85	6.45	6.10	6.46
T6 (6 Days)	6.65	6.45	6.15	6.41
T7 (7 Days)	6.85	6.80	6.45	6.70
Average	6.58	6.35	6.36	

Description: The same superscript in different rows and columns showed no significant difference (P>0.05).

Based on the results of this study, it can also be seen that the use of EM4 has no significant effect on increasing the pH value. And the length of time of fermentation also did not show any effect on increasing the pH value. Therefore, it can be said that the longer fermentation time with a dose of 1 to 3 percent EM4 use has no effect on the pH value. Because during the composting process the pH value will vary according to changes in the organic chemical composition. The degree of acidity in the pH of organic matter during the composting process always changes according to changes in the organic chemical composition [7].

3.6. Temperature

Table 7. Temperature Test Results on Fermented Compost with EM4 At a dose of Different

Fermentation Time (T)	EM4 (D) DOSAGE			Average
	D1 (1%)	D2 (2%)	D3 (3%)	
T1 (1 Day)	25,80	25.00	25.00	25,26ab
T2 (2 Days)	24.70	24.80	24.75	24.75ab
T3 (3 Days)	29.40	29,00	28.95	29.11c
T4 (4 Days)	26.45	26.65	26.85	26.65b
T5 (5 Days)	24.55	24.30	24.75	24.53ab
T6 (6 Days)	23.65	23.55	23.85	23.68a
T7 (7 Days)	23.85	23.90	23.55	23.76a
Average	25,48	25.31	25.38	

Description: Different superscripts in the same column show significant difference (P<0.05)

Based on the results of this study, it can also be seen that the use of EM4 has no significant effect on increasing the temperature value. But the length of time of fermentation has shown an effect on increasing the temperature value. The longer the fermentation time, the higher the temperature produced, until the temperature begins to decrease at a time that is said to be sufficient for the value of mature compost. If the temperature is still higher, it is estimated that the fermentation process is still active so that the compost has not been fully formed [8].

3.7. Carbon dioxide (CO2)

Table 8. Test Results for Carbon Dioxide in Fermented Compost with EM4 At different dosage

Fermentation Time (T)	EM4 (D) DOSAGE			Average
	D1 (1%)	D2 (2%)	D3 (3%)	
T1 (1 Day)	9057	7351	6303	7570
T2 (2 Days)	6940	7191	6770	6967
T3 (3 Days)	3928	4306	3150	3794
T4 (4 Days)	10000	10000	7880	9293
T5 (5 Days)	7425	6175	8342	7314
T6 (6 Days)	9646	9888	9161	9565
T7 (7 Days)	7498	7537	6333	7122
Average	7784	7492	6848	

Description: The same superscript in different rows and columns showed no significant difference (P>0.05)

Based on the results of this study, it can also be seen that the length of fermentation time and various doses of EM4 activator given did not affect the carbon dioxide value. This is because the longer the fermentation time is carried out, the higher the value of carbon dioxide so that the carbon dioxide gas can stop the activity of microorganisms that work to remodel organic matter in the manufacture of fermented compost.

3.8. Water content

Table 9. Moisture Content Test Results in Fermented Compost with EM4 At a dose of Different

Fermentation Time (T)	EM4 (D) DOSAGE			Average
	D1 (1%)	D2 (2%)	D3 (3%)	
T1 (1 Day)	43.77	35.69	51.06	43.50
T2 (2 Days)	59.87	38.29	38.56	45.57
T3 (3 Days)	50,16	56.81	41.39	49.45
T4 (4 Days)	43.69	88.62	38.95	57.08
T5 (5 Days)	48.41	49.14	40,70	46.08
T6 (6 Days)	36.64	38.58	50.93	42.05
T7 (7 Days)	42.44	48.78	42.37	44.53
Average	46.42	50.84	43.42	

Description: The same superscript in different rows and columns showed no significant difference (P>0.05)

Based on this research, we can see that the use of EM4 has no significant effect on the water content value because the length of fermentation time does not show any effect on the water content value. Due to the longer fermentation time, the water content will be less so that the decomposition process will not run properly if there is a lack of water content. The longer the

fermentation time, the water content produced will decrease and the decrease in water content occurs due to the longer fermentation time which results in increased microbial activity and more active enzymes. The length of time the fermentation takes place will result in a decrease in the water content produced, the decrease in water content is due to the longer fermentation time which makes the activity of microorganisms increase and the enzymes that are there are more active [9].

4. Conclusion

Based on the results of the study, it can be concluded that there was no interaction or influence between the length of fermentation time and the dose of EM4 use on the nutrient content which was said to have met the quality and maturity standards of fermented compost.

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